Development of Statewide GHG Inventories for the Forest Sector

Methods, Issues, and Opportunities

Board of Forestry Workshop

July 21, 2008

California Environmental Protection Agency

Air Resources Board

Overview

- Background on California's GHG emissions inventory and development process
- Current forest sector portion of the ARB statewide GHG inventory
- Review methods used to date
- Identify issues and areas for improvement
- Linkages, other issues, opportunities, next steps

California's GHG Emissions Inventory

- Includes emissions of six Kyoto gases (CO2, CH4, N2O, PFCs, HFCs, and SF6)
- Expressed in carbon dioxide equivalents (CO2e)
- Uses IPCC Second Assessment Report Global Warming Potentials
- Includes estimate of statewide "sinks" (removal of atmospheric CO2)
- ARB's GHG Inventory: http://www.arb.ca.gov/cc/inventory/data/data.htm

Emissions Inventory Development

- Statutory requirement (AB 1803)
- Began with Energy Commission estimates
- Improved data inputs and estimation methods where available
- Consistency with International Guidelines for GHG inventories
- AB 32 Requirement
  - ARB to determine 1990 statewide GHG level
  - Approve a 2020 emissions limit equivalent to the 1990 level (December 2007)

Current statewide forest sector GHG inventory

- Emissions and removals of CO2
- Emissions of CH4, N2O
- Approach: GHG flux estimation associated with biomass change
- Methods: remote sensing change detection, ground data, literature
- “Core” forest analysis: 1994-2000
- Three Northern California project areas (84% forest lands, 42% rangelands statewide): results scaled to statewide
- CO2 removals and GHG emissions backcast to 1990; forecast to 2004

Attributes of forest sector GHG inventory

Inventory of land-atmosphere GHG exchange
Atmospheric Flow Approach (IPCC 2006)
http://www.ipcc-nggip.iges.or.jp

Removals of CO_2 from atmosphere
Emissions of CO_2 to atmosphere
Net CO_2 flux estimate
Emissions of CH_4, N_2O to atmosphere

Atmospheric CO_2 Removals: Vegetation growth

Emissions by process:

Fire (wild and prescribed)
Slash decomposition
fuel wood combustion
Other disturbance
landfilled, composted wood products

Core analysis

Baseline Greenhouse Gas Emissions for Forest, Range, and Agricultural Lands in California. CEC PIER final report CEC-500-04-069F
http://www.energy.ca.gov/pier/project_reports/500-04-069.html

Biomass changes and corresponding CO2 removals/GHG emissions estimated for 1994 - 2000 for 3 project areas in northern CA

biomass by Smith et al. (2003) cover type, canopy closure class

biomass change: fire, harvest, regrowth, development, other/unverified

CDF-FRAP remote sensing products
(MSLCD, LCMMP change detection, cause of change)

Core analysis, con’d

Biomass pools

above/below ground live tree
understory vegetation, shrubs, grass
standing/down dead biomass, litter
(soils omitted)

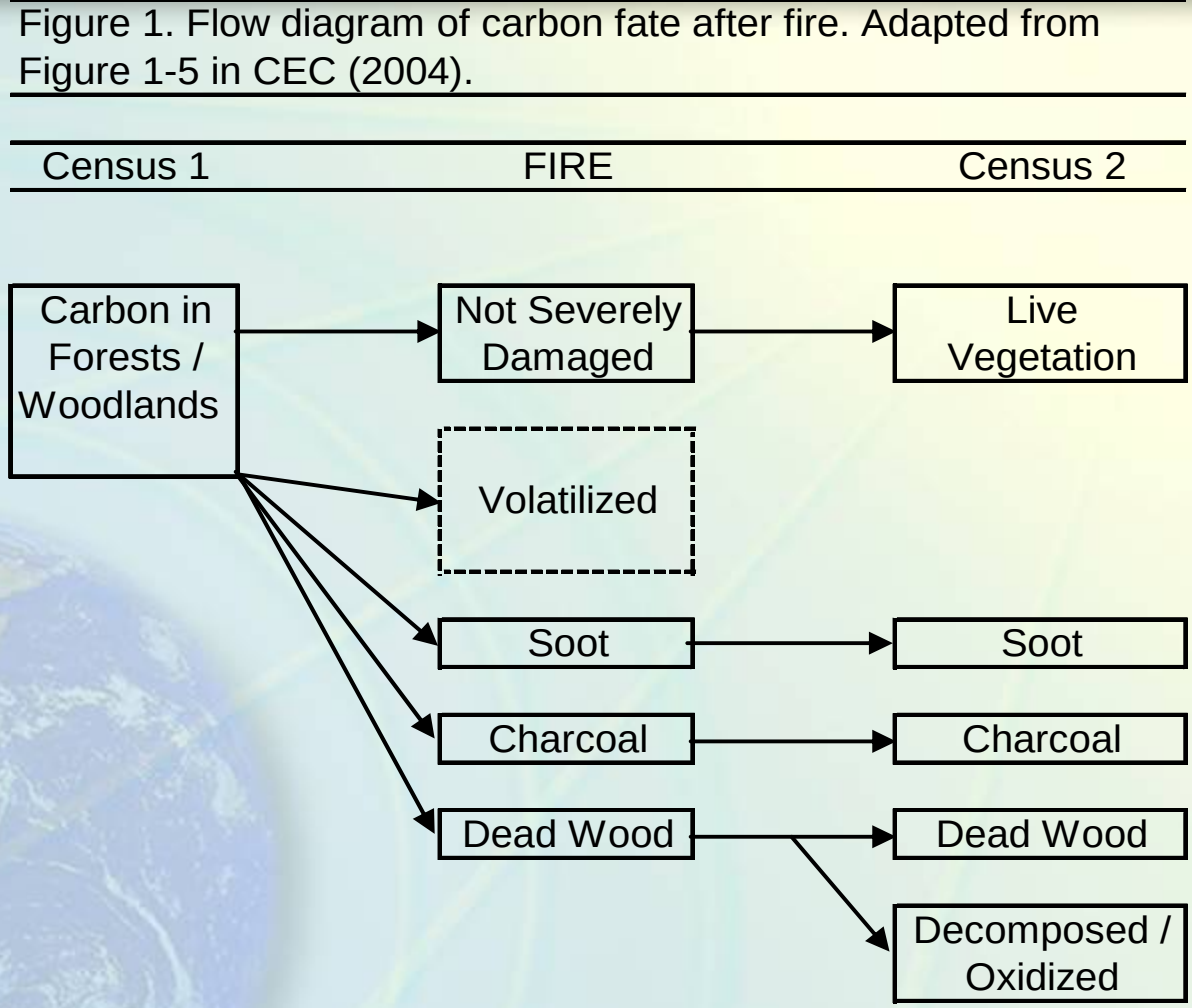
39 WHR classes cross-walked to 8 Smith et al. (2003) cover types,
5 canopy closure classes

canopy cover change → biomass change → emission/removal

undetected (saturation canopy): biomass, growth rates by cover type
(Birdsey and Lewis 2002)

study region CO2 removals/GHG emissions extrapolated to statewide

Figure 1. Flow diagram of carbon fate after fire. Adapted from Figure 1-5 in CEC (2004).



Forest GHG inventory: back-cast to 1990, forecast to 2004

http://www.energy.ca.gov/2006publications/cec-600-2006-013/cec-600-2006-013-sf.pdf

"shrinking forest land base" scaling approach (≠ forest modeling)

Back-cast from 1994 to 1990:
Applied -0.1707%/yr factor to GHG emissions and CO2 removals
Source: -7% forest land area decline 1953 - 1994
Shih (1998) The Land Base of California's Forests. CDF-FRAP.

Forecast from 2000 to 2004:
Applied -0.0755%/yr factor to GHG emissions and CO2 removals
Source: 4% timberland area decline projected 1997 – 2050
for Pacific Coast Region
USDA-FS (2004) PNW-GTR-613

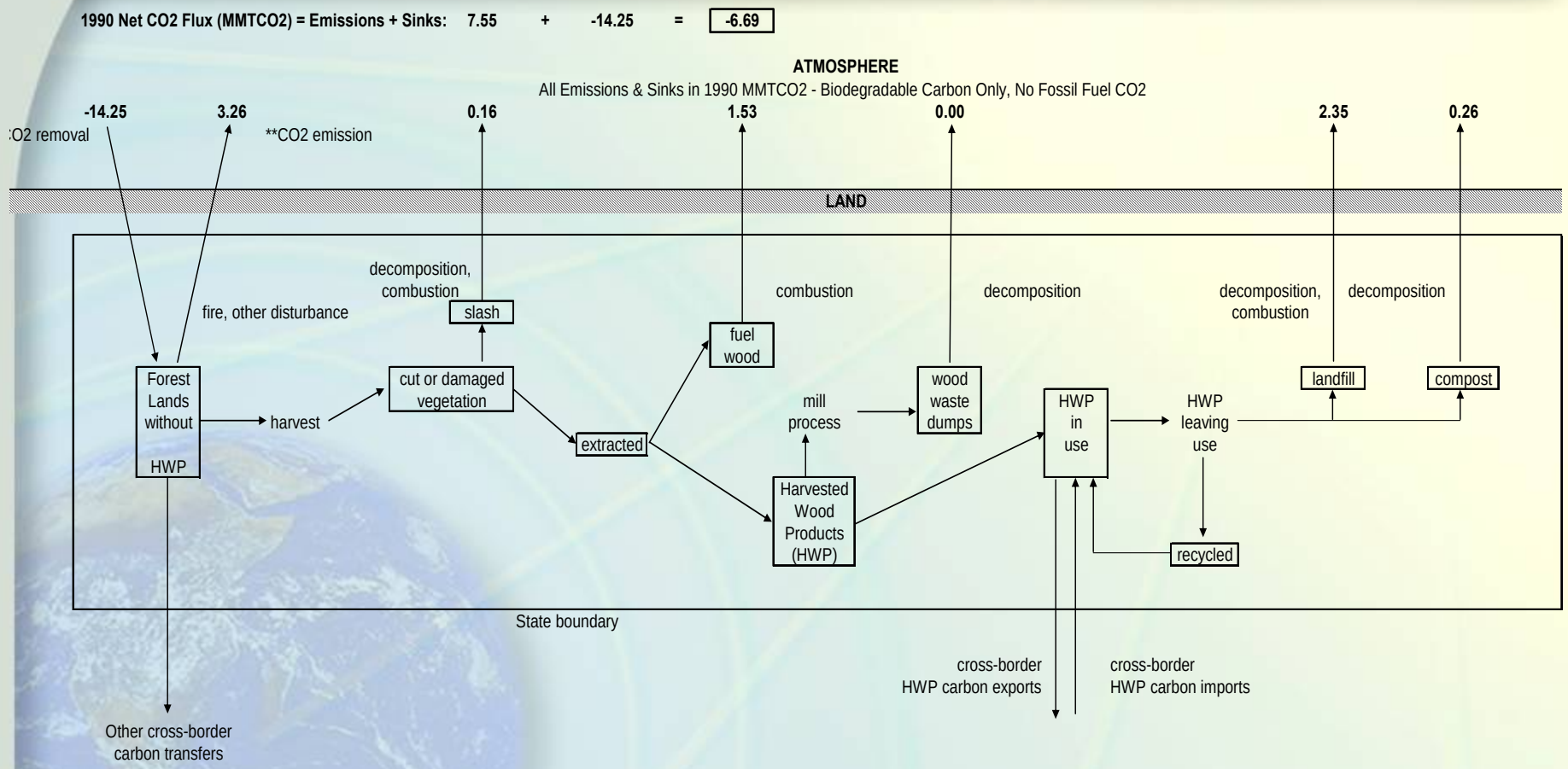
ARB forest sector GHG inventory: wood products

Wood products at end-of-use: landfills and composting

Developed CO_2, CH_4 emission estimates from product decomposition

CIWMB wood product waste data, IPCC O(1) decay model

Atmospheric Flow Approach to CO2 flux



http://www.arb.ca.gov/cc/inventory/data/tables/net_co2_flux_2007-11-19.pdf

Forest GHG inventory issues

Canopy cover change detection threshold insensitive

"many to one" forest cover type classification crosswalks from WHR to Smith et al. (2003)

limited use of FIA
(California FIA issues: PNW-GTR-750)

empirical regression equations relating canopy cover class to biomass

soil GHGs

extrapolation from regional to statewide

back-cast and forecast

Linkages, Needs, Opportunities

Collaboration (research, application development, review, capacity)

Identify issues, areas for inventory update and improvement, new science

monitoring: biomass, change detection, gases (FIA, AmeriFlux, NACP, etc.)

Forest inventories and GHG flux inventories: related (reconcilable?)
Biomass/fuels, biomass change and gas exchange

“Wall to wall” statewide coverage, other landscapes, year-to-year

Forest modeling: forecast forests, climate/management scenarios

Next Steps

Next editions of forest sector GHG inventory

evolving approach: multiple lines of evidence

combine modeling, monitoring (remote sensing, FIA, AmeriFlux, etc.)

soil GHGs

other land use: urban forests

collaboration, peer review

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GHG Inventory Website
http://www.arb.ca.gov/cc/inventory/inventory.htm